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(54) **Surface-coated wear-resistant member of cermet and process for producing same.**

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Description

This invention relates to a wear-resistant member of cermet, such as a blade member for a cutting tool, having a hard coating which exhibits excellent wear-resistance and toughness.

There have been extensively used surface-coated wear-resistant tool members, such as a blade member for a cutting tool, which comprise a substrate of cermet, such as cemented carbide including tungsten carbide (WC) and titanium carbide-based cermet, and a hard coating formed on a surface of the substrate and comprising one or more layers each composed of one of titanium carbide (TiC), titanium nitride (TiN), carbonitride of titanium (TiCN), oxy-carbide of titanium (TiCO), oxy-nitride of titanium (TiNO) and oxy-carbo-nitride of titanium (TiCNO). In some cases, such a coating further comprises an outermost layer of aluminum oxide (Al_2O_3) which is either in the amorphous form or the crystalline form.

Although such a conventional hard coating exhibits excellent wear-resistance, it is inferior in toughness, so that a crack can easily develop in the coating when the coating is subjected to bending stress during the operation of the wear-resistance tool member. In addition, this crack can be transmitted to the substrate of the tool member, so that the resistance of the tool member to breakage or damage is considerably lowered.

In order to overcome this difficulty, it has been proposed to form a coating of the above-mentioned titanium compounds by physical vapor deposition in such a manner that the thickness of the coating is kept as thin as possible and that the vapor deposition is carried out at temperatures of not more than 600°C to make the structure of the coating fine and less crystalline. This coating on the wear-resistant tool member can be suitably deformed when subjected to bending stress to prevent a crack from developing in the coating, thereby ensuring that the resistance of the tool member to breakage is not lowered. This procedure has been found not entirely satisfactory, however, in that such a coating cannot achieve a required wear resistance because the coating is thin and less crystalline.

Surface-coated wear-resistant tools as above-described are known. For example US-A-3,616,506 disclose a process of vapor depositing a TiC coating on a substrate of cemented carbide by CVD. JP-A-57,192,260 discloses a coated cemented carbide tool comprising a substrate, a first layer made of one or more of SiC, Sialon and Si_3N_4, a second layer made of one or more of TiC, TiN and Ti(C,N) rich and a third layer made of Al_2O_3. Also, EP-A-0 043 781 discloses a surface coated wear-resistant member. The coating layers are composed of TiN or TiN_x wherein x is greater than 0.4 and less than 1, the innermost layer being always TiN. From US-A-3,916,052 coatings of carbide-containing substrates with titanium carbide are known. The coating is formed onto a carbon-containing substrate by vapor-depositing titanium.

DE-A-3 030 149 discloses a surface-coated blade member for cutting tools comprising a metal substrate and a coating an at least one surface of said substrate, said coating being composed of one layer of vapor deposited titanium on the surface of said substrate and at least one layer of vapor deposited titanium compound on said layer of titanium. The layer of titanium compound is selected from the group consisting of TiN, TiC, TiCN, TiOC, TiOCN. With this structure, the strength of bonding between the metal substrate and the coating is enhanced.

It is therefore an object of this invention to provide a surface-coated wear-resistant member of cermet having a hard coating which, in addition to being highly wear-resistant, exhibits such excellent toughness that the coating can be suitably deformed when subjected to bending stress, thereby preventing a crack from developing in the coating.

Another object is to provide a process for producing such a surface-coated wear-resistant member.

According to a first aspect of the present invention, there is provided a surface-coated wear-resistant body comprising:

(a) a substrate of cermet; and

(b) a hard coating on a surface of said substrate, the coating having an average thiickness of 1 to 10 μm and comprising a vapor-deposited titanium compound consisting of

(i) titanium, nitrogen and optionally carbon, and/or

(ii) titanium and at least two of the elements carbon, nitrogen and oxygen,

wherein the atomic ratio of nitrogen, or carbon plus nitrogen, or carbon plus oxygen, or nitrogen plus oxygen, or carbon plus nitrogen plus oxygen to titanium in said coating is 0.3-0.8, said coating being made by depositing several Ti metal layers and several TiX layers alternately one upon another, to form a hard coating of a laminated construction on the surface, and wherein a TiX layer is formed between these layers, wherein X is at least nitrogen and optionally carbon, and/or at least two of carbon, nitrogen and oxygen.

According to a second aspect of the present invention, there is provided a process for producing such a surface-coated wear-resistant body which comprises the step of forming a coating comprising a titanium compound on a surface of a substrate of cermet by vapor-deposition, characterized in that said coating is formed by vapor-depositing several layers of titanium (Ti) metal and several layers of a titanium compound alternately

one upon another, said titanium compound being one of titanium nitride, carbo-nitride of titanium, oxy-carbide of titanium, oxy-nitride of titanium and oxy-carbo-nitride of titanium.

The hard coating comprises a compound of TiX and a compound of Ti_2X wherein X is at least nitrogen and optionally carbon or/and at least two of carbon, nitrogen and oxygen, TiX and Ti_2X being hereinafter referred to as "TiC.N.O" and "Ti_2C.N.O", respectively. The atomic ratio of one of carbon, nitrogen, carbon plus nitrogen, carbon plus oxygen, nitrogen plus oxygen, and carbon plus nitrogen plus oxygen to titanium (hereinafter referred to as "(C+N+O)/Ti") in the hard coating is in the range of between 0.3 and 0.8. With this construction, the hard coating has a fine structure and has such deformability or toughness as to absorb bending stress applied to the surface-coated wear-resistant member during an operation thereof, thereby preventing a crack from developing in the coating to ensure that the member is not subjected to breakage or damage. In addition, the hard coating possesses excellent wear-resistance which further enhances the overall wear-resistance of the member. The presence of titanium metal in the hard coating will further enhance the toughness of the coating.

If the atomic ratio, i.e., (C+ N + O)/Ti, is less than 0.3, the proportion of Ti_2C.N.O plus titanium metal to TiC.N.O becomes too large, so that the hardness of the coating is lowered. As a result, the wear-resistance afforded by TiC.N.O is adversely affected. On the other hand, if the atomic ratio is more than 0.8, the proportion of Ti_2C.N.O to TiC.N.O or the proportion of Ti_2C.N.O plus titanium metal to TiC.N.O becomes too small, so that the coating fails to possess the required deformability (toughness) to absorb the bending stress applied to the hard coating during the operation of the surface-coated wear-resistant member.

The hard coating has an average thickness of 1 to 10 μm. If this thickness is less than 1 μm, the required toughness of the coating cannot be achieved. On the other hand, if the thickness is more than 10 μm, the toughness of the coating is also lowered.

The hard coating is formed on the surface of the substrate of the member by vapor-depositing several layers of titanium(Ti) metal and several layers of a titanium compound alternately one upon another, the titanium compound being one of titanium nitride, carbo-nitride of titanium, oxy-carbide of titanium, oxy-nitrate of titanium and oxy-carbo-nitride of titanium, an atomic ratio of one of carbon, nitrogen, carbon plus nitrogen, carbon plus oxygen, nitrogen plus oxygen and carbon plus nitrogen plus oxygen to titanium(Ti) in the coating being in the range of between 0.3 and 0.8. Vapor depositions used as method for forming the hard coating include chemical vapor deposition, a low-temperature chemical vapor deposition method using an organic agent, or various physical vapor deposition methods. Preferably, in order that the resultant coating can be highly crystalline and excellent in wear-resistance, the coating should be vapor-deposited on the substrate at temperatures of 600°C to 1,000°C.

The hard coating comprising TiC.N.O, Ti_2C.N.O and titanium metal can be formed on the substrate surface by vapor-depositing alternately layers of titanium metal and TiC.N.O because the compound of Ti_2C.N.O is formed by diffusion between each adjacent layers.

The hard coating may have an outermost layer of Al_2O_3 to further enhance its wear-resistance.

The invention will now be illustrated by the following examples:

Example 1

There was prepared, as a substrate, a drawing die which was made of sintered cemented carbide which contained, apart from impurities, 12% by weight of Co and balance WC, the substrate having a hole extending therethrough for passing a material to be drawn therethrough. Then, seven layers of Ti metal each having an average thickness of 0.15 μm and seven layers of TiN each having an average thickness of 0.3 μm were alternately vapor-deposited one upon another at a temperature of 800°C by an ion-plating method to form a hard coating of a laminated construction on the surface of the hole of the drawing die to provide a surface-coated wear-resistant drawing die of the present invention, the coating having an average thickness of about 3 μm.

For comparison purposes, a comparative drawing die of the conventional type was also prepared according to the above procedure except that a hard coating was composed of TiN, the coating having an average thickness of about 3 μm.

In the drawing die of the present invention, the atomic ratio of N to Ti was 0.65, and it was confirmed by X-ray diffraction that the hard coating contained both TiN and Ti_2N. The drawing die of the present invention had a transverse rupture strength of 290 kg/mm² while the comparative drawing die had a transverse rupture strength of 210 kg/mm² because the toughness of the coating was lower.

Also, the drawing die of the present invention and the comparative drawing die were used for drawing a stainless steel wire having a diameter of 2 mm at a reduction rate of 15%. The drawing die of the present invention became ineffective when it produced 3,000 m of drawn steel wire. On the other hand, the comparative drawing die became ineffective when it produced only 1,000 m of drawn steel wire. Thus, the service life of

the drawing die of the present invention was substantially longer than that of the comparative drawing die.

Example 2

There was prepared, as a substrate, a throw-away blade member or insert (ISO.P30) made of a sintered cermet containing, apart from impurities, 9% by weight of Co, 10% of TiC, 10% of TaC and balance WC. Then, six layers of Ti metal each having an average thickness of 0.2 μm and six layers of TiN each having an average thickness of 0.3 μm were alternately vapor-deposited one upon another at a temperature of 650°C by an ion-plating method to form a hard coating of a laminated construction on a surface of the substrate to produce a surface-coated blade member A of the present invention, the coating having an average thickness of about 3 μm.

Also, a layer of Al_2O_3 having an average thickness of 1 μm was vapor-deposited on the coating of the blade member A by a plasma chemical vapor deposition method to produce a surface-coated blade member B of the present invention.

In the coating of each of the blade members A and 8, the atomic ratio of N to Ti was 0.55. It was confirmed by X-ray diffraction that each coating contained TiN, Ti_2N and Ti metal.

A comparative blade member of the conventional type was also prepared according to the procedure except that a coating was composed of TiN, the coating having an average thickness of about 3 μm.

The blade members A and B of the present invention and the comparative blade member were subjected to a continuous cutting test in a lathe. The conditions for this continuous cutting test was as follows:

Workpiece: a steel bar of a circular cross-section (JIS.SNCM-8; Hardness: HB240)
Cutting speed: 125 m/minute
Feed rate: 0.32 mm/revolution
Depth of cut: 1.5 mm

An intermittent cutting test in a lathe was also carried out under the following conditions:

Workpiece: a steel bar having peripheral projections for engagement with the blade member (JIS-.SNCM-8; Hardness: HB280)
Cutting speed: 100 m/minute
Feed rate: 0.33 mm/revolution
Depth of cut: 2 mm
Cutting time: 2 minutes

In the continuous cutting test, each blade member attached to a blade holder was used to continuously turn the workpiece to determine how long it took for the flank of the blade member to be worn 0.3 mm. In the intermittent cutting test, it was determined how many blade members of the same construction out of ten were subjected to chipping.

The results of the continuous and intermittent cutting tests are shown in Table below.

TABLE

Kind of blade member	Cutting time for 0.3 mm flank wear (min.)	Number of chipped blade members/number of tested blade members
Blade member A	25	0/10
Blade member B	43	1/10
Comparative blade member	26	9/10

As seen from Table, the blade member A of the present invention exhibited substantially the same wear-resistance as the comparative blade member, and the blade member B of the present invention was much superior in wear-resistance to the comparative blade member. None of the tested blade members A was subjected to chipping, and only one of the tested blade members B was subjected to chipping. On the other hand, nine of the tested comparative blade members were subjected to chipping. Thus, the hard coating of each of the blade members A and B exhibited much more toughness than that of the comparative blade member, and therefore achieved a higher cutting performance in the intermittent steel cutting test in which a substantial bending stress was exerted on the tested blade members.

Example 3

There was prepared, as a substrate, a cold-forging die for forming a cross-shaped slot in a screw head which die was made of cemented carbide containing, apart from impurities, 20% by weight of Co and balance WC. Then, three layers of Ti metal each having an average thickness of 0.12 µm and three layers of $TiC_{0.2}N_{0.6}O_{0.2}$, each having an average thickness of 0.3 µm were alternately vapor-deposited one upon another at a temperature of 700°C by an ion-plating method to form a hard coating of a laminated construction on a surface of the substrate to produce a surface-coated cold-forging die, the coating having an average thickness of about 1.3 µm.

In the coating of the cold-forging die of the present invention, the atomic ratio of C plus N plus O (C+N+O) to Ti was 0.7, and it was confirmed that the coating contained TiCON, Ti_2N and Ti.

Also, a comparative forging die of the conventional type was prepared according to the above procedure except that a coating was made of $TiC_{0.2}N_{0.6}O_{0.2}$.

The cold-forging die of the present invention could process 200,000 screws (JIS.S55C) to form a cross-shaped slot in the head of each screw by cold forging before the cold forging die became ineffective. On the other hand, the comparative die could only process 50,000 screws before it became ineffective. Thus, the cold-forging die of the present invention had a substantially longer service life than the comparative die.

Example 4

There was prepared, as a substrate, a throw-away blade member or insert made of a sintered cermet containing, apart from impurities, 5% by weight of Co, 10% of Ni, 10% of Mo, 20% of TiN and balance TiC. Then, five layers of Ti metal each having an average thickness of 0.2 µm and five layers of $TiC_{0.3}N_{0.7}$ each having an average thickness of 0.4 µm were alternately vapor-deposited one upon another at a temperature of 900°C by a sputtering method to form a hard coating of a laminated construction to produce a surface-coated blade member of the present invention, the coating having an average thickness of about 3 µm. The atomic ratio of C plus N (C+N) to Ti was 0.65, and it was confirmed that the coating contained TiCN and Ti_2CN.

A comparative blade member was also prepared according to the above procedure except that a coating was made of $TiC_{0.3}N_{0.7}$. The surface-coated blade member of the present invention and the comparative blade member were subjected to a turning test. The conditions for this turning test were as follows:

Workpiece: A grooved steel bar of a circular cross-section (JIS.SNCM-8; Hardness: HB270)
Cutting speed: 180 m/minute
Feed rate: 0.3 mm/revolution
Depth of cut: 2 mm

In the turning test, it took 30 minutes for the blade member of the present invention to become ineffective while it took 20 minutes for the comparative blade member to become ineffective. Thus, the service life of the blade member of the present invention was substantially longer than that of the comparative blade member.

Claims

1. A surface-coated wear-resistant body comprising:
   (a) a substrate of cermet; and
   (b) a hard coating on a surface of said substrate, the coating having an average thickness of 1 to 10 µm and comprising a vapor-deposited titanium compound consisting of
      (i) titanium, nitrogen and optionally carbon , and/or
      (ii) titanium and at least two of the elements carbon, nitrogen and oxygen,

   wherein the atomic ratio of nitrogen, or carbon plus nitrogen, or carbon plus oxygen, or nitrogen plus oxygen, or carbon plus nitrogen plus oxygen to titanium in said coating is 0.3-0.8, said coating being made by depositing several Ti metal layers and several TiX layers alternately one upon another, to form a hard coating of a laminated construction on the surface, and wherein a Ti_2X layer is formed between these layers, wherein X is at least nitrogen and optionally carbon, and/or at least two of carbon, nitrogen and oxygen.

2. A surface-coated wear-resistant body according to Claim 1 wherein said coating further comprises titanium metal.

3. A surface-coated wear-resistant body according to Claim 1 or Claim 2, wherein said coating further comr-

ises an outermost layer of vapor-deposited Al_2O_3.

4. A process for producing a surface-coated wear-resistant body according to any preceding claim, which comprises the step of forming a coating comprising a titanium compound on a surface of a substrate of cermet by vapor-deposition, characterized in that said coating is formed by vapor-depositing several layers of titanium (Ti) metal and several layers of a titanium compound alternately one upon another, said titanium compound being one of titanium nitride, carbo-nitride of titanium, oxy-carbide of titanium, oxy-nitride of titanium and oxy-carbo-nitride of titanium.

5. A process according to Claim 4, wherein said coating consists of TiN and Ti_2N and has an atomic ratio of N to Ti of 0.65, characterised by vapor-depositing alternately layers of Ti metal and layers of TiN.

6. A process according to Claim 4, wherein said coating consists of TiN, Ti_2N and Ti metal and has an atomic ratio of C plus N plus O (C+N+O) to Ti of 0.7, characterised by vapor-depositing alternately layers of Ti metal and layers of TiN.

7. A process according to Claim 4, wherein said coating consists of TiCON, Ti_2N and Ti metal and has an atomic ratio of C plus N plus O (C+N+O) to Ti of 0.7, characterised by vapor-depositing alternately layers of Ti metal and layers of $Ti_{0.2}N_{0.6}O_{0.2}$.

8. A process according to Claim 4, wherein said coating consists of TiCN and Ti_2CN and has an atomic ratio of C plus N (C+N) to Ti of 0.65, characterised by vapor-depositing alternately layers of Ti metal and layers of $TiC_{0.3}N_{0.7}$.

9. A process according to any of Claims 4-8 characterized by vapor-depositing an outermost layer of Al_2O_3 as part of the coating.

10. A process according to any of Claims 4-8 characterized by vapor-depositing each layer at temperatures of 600-1000°C.

Revendications

1. Corps résistant à l'usure, à revêtement de surface, comprenant :
   (a) un substrat de cermet, et
   (b) un revêtement dur sur une surface dudit substrat, le revêtement ayant une épaisseur moyenne de 1 à 10 µm et comprenant un composé du titane, déposé à partir d'une phase vapeur, consistant par :
      (i) du titane, de l'azote et éventuellement du carbone, et/ou
      (ii) du titane et au moins deux éléments pris parmi le carbone, l'azote et l'oxygène,

   le rapport atomique de l'azote, ou du carbone plus l'azote, ou du carbone plus l'oxygène, ou de l'azote plus l'oxygène, ou du carbone plus l'azote plus l'oxygène, au titane dans ledit revêtement étant de 0,3 à 0,8, ledit revêtement étant obtenu par dépôts alternés de plusieurs couches de titane métal et plusieurs couches de TiX l'une sur l'autre, de façon à former sur la surface un revêtement dur ayant une structure stratifiée, et une couche de Ti_2X étant formée entre ces couches, X étant au moins l'azote et éventuellement le carbone, et/ou au moins deux des éléments pris parmi le carbone, l'azote et l'oxygène.

2. Corps résistant à l'usure, à revêtement de surface, selon la revendication 1, dans lequel ledit revêtement contient en outre du titane métal.

3. Corps résistant à l'usure, à revêtement de surface, selon la revendication 1 ou 2, dans lequel ledit revêtement comprend en outre une couche extérieure de Al_2O_3 déposée à partir d'une phase vapeur.

4. Procédé de production d'un corps résistant à l'usure, à revêtement de surface, selon l'une quelconque des revendications précédentes, qui comprend l'étape de formation d'un revêtement comprenant un composé du titane sur une surface d'un substrat de cermet par dépôt à partir d'une phase vapeur, caractérisé en ce que l'on forme le revêtement en déposant, à partir d'une phase vapeur, plusieurs couches de titane métal (Ti) et plusieurs couches d'un composé du titane, alternativement l'une sur l'autre, ledit composé du titane étant choisi parmi le nitrure de titane, le carbonitrure de titane, l'oxycarbure de titane, l'oxynitrure de titane et l'oxycarbonitrure de titane.

5. Procédé selon la revendication 4, dans lequel ledit revêtement consiste en TiN et Ti_2N et possède un rapport atomique de N à Ti de 0,65, caractérisé par le dépôt alterné, à partir d'une phase vapeur, de couches de titane métal et de couches de TiN.

6. Procédé selon la revendication 4, dans lequel ledit revêtement consiste en TiN, Ti_2N et titane métal et possède un rapport atomique de C plus N plus O (C+N+O) à Ti de 0,7, caractérisé par le dépôt alterné, à partir d'une phase vapeur, de couches de titane métal et de couches de TiN.

7. Procédé selon la revendication 4, dans lequel ledit revêtement consiste en TiCON, Ti_2N et titane métal et possède un rapport atomique de C plus N plus O (C+N+O) à Ti de 0,7, caractérisé par le dépôt alterné, à partir d'une phase vapeur, de couches de titane métal et de couches de $Ti_{0.2}N_{0.6}O_{0.2}$.

8. Procédé selon la revendication 4, dans lequel ledit revêtement consiste en TiCN et Ti_2CN et possède un rapport atomique de C plus N (C+N) à Ti de 0,65, caractérisé par le dépôt alterné, à partir d'une phase vapeur, de couches de titane métal et de couches de $TiC_{0.3}N_{0.7}$.

9. Procédé selon l'une quelconque des revendications 4 à 8, caractérisé par le dépôt à partir d'une phase vapeur d'une couche extérieure de Al_2O_3 en tant que partie du revêtement.

10. Procédé selon l'une quelconque des revendications 4 à 8, caractérisé en ce que chaque couche est déposée à partir d'une phase vapeur à des températures situées dans l'intervalle allant de 600 à 1000°C.

Patentansprüche

1. Oberflächenbeschichteter, abriebbeständiger Körper, umfassend:
   (a) ein Substrat aus Cermet; und
   (b) einen harten Überzug auf einer Oberfläche des Substrates, wobei der Überzug eine durchschnittliche Dicke von 1 bis 10 µm aufweist und eine dampfabgeschiedene Titanverbindung umfasst, bestehend aus
      (i) Titan, Stickstoff und gegebenenfalls Kohlenstoff und/oder
      (ii) Titan und wenigstens zwei der Elemente Kohlenstoff, Stickstoff und Sauerstoff,

   worin das Atomverhältnis von Stickstoff oder Kohlenstoff plus Stickstoff oder Kohlenstoff plus Sauerstoff oder Stickstoff plus Sauerstoff oder Kohlenstoff plus Stickstoff plus Sauerstoff zu Titan in dem Überzug 0,3 bis 0,8 ist, wobei der Überzug durch Niederschlagen mehrerer Ti-Metallschichten und mehrerer TiX-Schichten alternierend übereinander gebildet ist, zur Bildung eines harten Überzuges aus einem laminierten Aufbau auf der Oberfläche, und worin eine Ti_2X-Schicht zwischen diesen Schichten gebildet ist, worin X wenigstens Stickstoff und gegebenenfalls Kohlenstoff und/oder zwei von Kohlenstoff, Stickstoff und Sauerstoff ist.

2. Oberflächenbeschichteter, abriebbeständiger Körper gemäss Anspruch 1, bei dem der Überzug weiterhin Titanmetall umfasst.

3. Oberflächenbeschichteter abriebbeständiger Körper gemäss Anspruch 1 oder Anspruch 2, bei dem der Überzug weiterhin als äusserste Schicht dampfabgeschiedenes Al_2O_3 umfasst.

4. Verfahren zur Herstellung eines oberflächenbeschichteten, abriebbeständigen Körpers gemäss einem der vorhergehenden Ansprüche, umfassend die Stufe, dass man einen Überzug, umfassend eine Titanverbindung, auf einer Oberfläche eines Substrates aus Cermet durch Dampfabscheidung bildet, dadurch **gekennzeichnet**, dass der Überzug durch Dampfniederschlag mehrerer Schichten aus Titan (Ti)-metall und mehrerer Schichten aus einer Titanverbindung alternierend übereinander gebildet ist, wobei die Titanverbindung eine von Titannitrid, Carbonitrid von Titan, Oxycarbid von Titan, Oxynitrid von Titan und Oxycarbonitrid von Titan ist.

5. Verfahren gemäss Anspruch 4, bei dem der Überzug aus TiN und Ti_2N besteht und ein Atomverhältnis von N zu Ti von 0,65 vorliegt, dadurch **gekennzeichnet**, dass man alternierend Schichten aus Ti-Metall und Schichten von TiN dampfabscheidet.

6. Verfahren gemäss Anspruch 4, bei dem der Überzug aus TiN, Ti_2N und Ti-Metall besteht und ein Atom-

verhältnis von C plus N plus O (C+N+O) zu Ti von 0,7 vorliegt, dadurch **gekennzeichnet**, dass man alternierend Schichten von Titanmetall und Schichten von TiN dampfabscheidet.

7. Verfahren gemäss Anspruch 4, bei dem der Überzug aus TiCON, Ti_2N und Ti-Metall besteht und ein Atomverhältnis von C plus N plus O (C+N+O) zu Ti von 0,7 vorliegt, dadurch **gekennzeichnet**, dass man alternierend Schichten von Ti-Metall und Schichten von $Ti_{0,2}N_{0,6}O_{0,2}$ dampfabscheidet.

8. Verfahren gemäss Anspruch 4, bei dem der Überzug aus TiCN und Ti_2CN besteht und ein Atomverhältnis von C plus N (C+N) zu Ti von 0,65 hat, **gekennzeichnet**, von alternierenden Schichten aus Ti-Metall und Schichten von $TiC_{0,3}N_{0,7}$.

9. Verfahren gemäss einem der Ansprüche 4 bis 8, **gekennzeichnet** durch Dampfabscheiden einer äussersten Schicht von Al_2O_3 als Teil des Überzuges.

10. Verfahren gemäss einem der Ansprüche 4 bis 8, **gekennzeichnet** durch Dampfabscheiden einer jeden Schicht bei Temperaturen von 600 bis 1000°C.